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ABSTRACT

This paper reviews some of the cognitive and linguistic functions which develop during the period of concrete operational thought (ages 4-9) as defined in Piaget's developmental theory. Discussion centers on the formation of classes and relations and the development of the language associated with these operations. Also discussed are conservation and the linguistic structures associated with it and selected research studies. The literature reviewed suggests that there is a relationship between language and cognitive development in the concrete operations period. (SDH)

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Language and Cognition in the Concrete Operations Period[1]

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The purpose of this paper is to highlight some of the similarly developing cognitive and linguistic functions in the early school years, that is, during the period of concrete operational thought as defined by Piaget's developmental theory (Piaget, 1973). The age period with which we are concerned here extends roughly from 4 to 9 years. It is the time during which the child is learning to apply the operatory structures of thought in logical ways to concrete (as opposed to abstract) situations. Piaget (1973) describes operations as internalized actions which are acts of intelligence that effect some conceptual organization or transformation of a particular set of objects or materials. The understanding of the concept of number and the formation of classes and relations forms a system of operations that allow a child to comprehend that a movement (i.e., a transformation) in one direction can be reversed to reach the original state (Furth, 1970). This ultimately leads the child to an understanding of the concept of conservation, the crucial development of the concrete operational period.

During this same period of time the child is refining his linguistic skills. Menyuk notes that

> "...By the time the child enters kindergarten he seems to understand some quite complicated structures...but there are limits to this understanding....Structures which involve transformational operations that disturb the subject-verb-object order are difficult for him to interpret and these structures continue to be difficult for some time." (Menyuk, 1972, p. 12)

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Facility in using and understanding the passive voice form is developing (Turner & Rommetveit, 1967), as well as the promise and easy to see verb forms as outlined by C. Chomsky (1969). The child is also expanding his usage of logical relationships beyond simple conjoining and causative elements (Menyuk, 1969).

This paper will review the formation of classes and relations and the development of the language associated with these operations. The concept of conservation and the linguistic structure associated with it will then be discussed, and selected research comparing the two will be examined. Suggestions for future work to clarify the methodological procedures leading to conclusions about the relationship between conservation and the passive voice form will be made.

First let us consider the concept of classes. Children at the level of preoperational or intuitive thought can already sort a group of objects into separate piles, or match their sortings to a sample. However, there is no evidence of operational structures here because the sortings are based on perceptual similarity and spatial proximity among the group of objects. The child is incapable of performing operations on the classes which require an understanding of their logical structure. In other words, the classes lack consistency and exhaustiveness, which the child does not use until the onset of concrete operations. Wohlwill states that it "...appears plausible to suppose that this change (i.e., from spatio-perceptual groupings to logically consistent ones) reflects the elaboration of verbal mediators...which permit the child to organize his categories into an exhaustive set and to maintain this set during the course of the sorting task (Wohlwill, 1966, p. 61)." Bruner & Kenney

(1966), examined children's performance on a double classification matrix task, which consisted of 9 glasses arranged in a 3 x 3 grid, each row varying in 3 degrees of height and width. The children were asked to describe how the glasses in a row and a column were alike and how they were different. The results indicated that the children used one of three linguistic modes to report their explanations. One mode was dimensional, in which the child singled out 2 ends of a continuum saying for example, "That one is higher, and that one is shorter." A second mode was global, in which the child focused on one dimension and said, "That one is bigger and that one is little." The third type of linguistic mode was labelled confounded because the child used both dimensional and global terms in describing the glasses. For example, a child using a confounded mode would say, "That one is taller and that one is little." Bruner and Kenney noted that children who used the confounded mode were more likely to fail to reproduce a transposed matrix than those who used either dimensional or global terms indicating that a relationship exists between the concept of class formation and language terms describing classes.

The understanding of relations is another important facet of concrete operations. At the preoperational level, the child can readily make discriminations between 2 objects (e.g., judgments of more and less, larger and smaller, etc.). This is a purely perceptual skill, however, with the conceptual element entering when the child can order a set of objects. The critical aspect here is the understanding of a series of objects as a set of transitive relations in which each element is both larger, heavier, etc. than the preceding element, and smaller, lighter, etc. than the succeeding one. If a relationship between language and cognitive development does exist, it is reasonable to expect that facility with the use of relational terms would be developing during the same

period of time as the concept of relations. Hamel et al. (1972) tested for conservation of liquid quantity by using beakers of water of various size and number. A test of relational terms using continuous and discontinuous materials was then administered. The discontinuous items were discrete objects (such as flowers, birds, etc.) that were grouped together in different numbers. To test for knowledge of relational terms the children were asked to point to groups that had more, less, or the same amount. For the test with continuous items, pictures of beakers of water differing in height and width were used. Again the children were asked to indicate which beaker contained more, less, or the same amount of water compared to a beaker the experimenter pointed out. The results showed that when the children were divided into conservers and nonconservers, the conservers performed better on the relational terms test than the non-conservers. Sinclair's (1967) work on language development similarly verifies this relationship. Her research has shown that conservers used more relational terms (e.g., more-less), more opposites (e.g., long-short), and more coordinated descriptions of 2 attributes (e.g., more marbles, but they are smaller) than nonconservers. An experiment by Peisach (1973) further corroborates these results. Measures of conservation of liquid and solid quantities and the comprehension and use of dimensional language were compared. Four measures of dimensional language usage were taken, including nonconjunctive, conjunctive, expressive, and conservation tasks. In the nonconjunctive task, the child was required to attend to one dimension of a pair of discontinuous items. The experimenter read a sentence such as "Point to the sponge that is narrower" and the child pointed to the item he thought was correct. The conjunctive task required that the child attend to two dimensions simultaneously in order to respond to a request such as "Point to the candle that is fatter and shorter

than the other candles." In the expressive dimensional task the child was shown pairs of items and was prompted to describe the similarities and differences between them. The dimensional conservation task involved the materials used to test for conservation. The child was shown a set of elements and prompted to describe the similarities and differences between the elements. No direct questions about dimensionality were used in the promptings for either the expressive or conservation tasks. Significant correlations were obtained between the scores on conservation of quantity and both the nonconjunctive and conjunctive dimensional tasks, indicating a relationship between the cognitive structure of conservation and its associated dimensional language. Conservers were found to use more differentiated dimensional language than nonconservers. However, when comparing the expressive language and dimensional conservation scores, it was found that the children used less mature dimensional language on the conservation task than on the language task. This led Peisach to conclude that the arguments that cognitive structures are a necessary prerequisite to the associated language structure could not be supported. However, this conclusion may have been necessitated by the fact that the dimensional conservation task was more difficult than the expressive dimensional task.

The transition from preoperational to concrete operational thought is attained by an understanding of the concept of conservation. In learning to conserve the child learns that the system of relationships among various physical dimensions does not change with a change in form. This means that the child learns the reversible nature of operations. For example, rolling a ball of clay into a sausage changes the perceptual aspects of the clay, but does not change the absolute quantity of clay, and by rolling it back into a ball the transformation can be demonstrated to be reversible. In order to

understand reversibility the child must be able to decenter his perceptions, so that he is not overwhelmed by the physical appearance changes. Resisting the perceptually deceptive apparent change and holding on to the logical necessity of constancy in certain dimensions requires the child to attend to the transformation rather than attending exclusively to the static beginning and ending configurations. The notion of logical transformations has a parallel in the linguistic sphere, as delineated by Chomsky (1965). In a linguistic transformation, the structural relationship between sentence elements is conserved. For example, the active voice sentence, "The truck pushed the car" can be transformed into the passive voice sentence, "The car was pushed by the truck" by reversing the subject and object, and inserting the auxiliary word by. Both sentences contain the same deep structure with variation only in the surface structure.

The relationship between reversibility on seriation and classification tasks and comprehension of passive sentences was examined by Beilin and Spontak (1969). Comprehension was tested by having a child select which of two pictures he felt illustrated a sentence presented verbally, and also by having the child act out with dolls the active and passive sentences presented to him. Their results indicated that in kindergarten poor performance on the reversibility task was associated with poor comprehension of passive sentences. In the first grade, a higher level of reversibility was found, but the comprehension of passive sentences was still poor. This may indicate a lag in development such that the cognitive structure for reversibility is established before the language structure for passives. The subjects in the second grade showed a high correlation between comprehension of passives and reversibility. Studies by Hutson (1971), and Noval and Ambrosino (1973) also showed a moderate relation-

ship between the comprehension of passive voice sentences and the ability to conserve substance and weight.

Scholnick and Adams (1973) have taken a somewhat different approach to the problem of the relation of syntactic and cognitive structures. They used nonsense syllables for the actors and recipients in passive sentences in order to eliminate cognitive cues, and compared the performance on this task with the child's ability to repeat reversed active sentences, and their performance on reversing a double classification matrix. The results showed significant correlations between all 3 variables. This appears to indicate that there is a relation between the cognitive and linguistic tasks, although the authors caution that nothing more than a weak relationship should be posited. This weak relationship may be the result of too much overlap of the sentence reversal scores into the linguistic as well as the cognitive domain. The sentence reversal task consisted of an active voice sentence which the child had to repeat in reversed order. This involves a good deal of linguistic facility in overcoming the nonsensical meaning of some of the transformed sentences. For example the sentence, "John washed the dishes" would be reversed into "The dishes washed John" which is a highly improbable event. This improbability must be overcome in order to respond correctly on the task, which may shade the real results of the experiment.

From the literature reviewed here, there does appear to be reasonable grounds to support the statement that there is a relationship between language and cognitive development in the concrete operations period. However, the extent and directionality of this relationship is far from being established, as can be seen from the conflicting conclusions reached in various studies.

For example, Beilin and Spontak (1969) found that an understanding of reversibility preceded accurate comprehension of the passive voice form, while Scholnick and Adams (1973) concluded that children could understand passives without having mastery of reversibility. This lack of consistent results points back to the arguments made by Clark (1974) that the research methodology must be carefully examined and refined, and also that the idea that the relationship between linguistic and cognitive structures changes at various points along the developmental continuum must be entertained. It is suggested that what is necessary now are studies comparing the various experimental techniques used in the research on the relation between language and cognition in the concrete operational period.

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